MOTT MACDONALD

IE Report
Malta Delimara 3 PS
Fuel Conversion

Performance Acceptance Test (2) - Phase II
D3 Power Generation Ltd

20 March 2018

D3 Power Generation Ltd

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Contents

Executive summary

On 8 March 2018 Mott MacDonald witnessed the acceptance tests post conversion of the eight Wärtsilä diesel engines firing natural gas. This report is to confirm the witnessing of the test and the measured performance of engines 41, 42, 43 and 44 after conversion to spark ignition, engines 45, 46, 47 and 48 after conversion to and operating in dual fuel mode, and all engines operating in combined cycle with the steam turbine.

The objective of the acceptance tests is to measure the heat rate, power, emissions and noise of the units, and compare the results to the pre-conversion redelivery test results. As the noise test has been passed previously it was not considered necessary to repeat.

The test schedule can be summarised as follows:

> Witness Performance Acceptance Tests on natural gas 8 March 2018 with all engines in service at 80% and 100% load, and as explained in more detail in the Minghua test procedure.

Shanghai Minghua Electric Power Technology Engineering Co. Ltd conducted the tests, which were witnessed by Stephen David from Mott MacDonald.

Approximately one hour after starting the 100% load run, a fault with the main steam inlet thermocouple led to shut-down of the STG. It was discussed and agreed with Shanghai Minghua and D3PG that the data gathered on the STG performance could be extrapolated to the remainder of the test in order to determine the plant heat rate and output. This is considered acceptable by Mott MacDonald because the STG performance had been very steady (an average load was extrapolated over the steady period), and whether or not it is in service does not impact the performance of the engine generator sets. The eight engines remained in service for the remainder of the test.

Mott MacDonald confirms that it has witnessed the performance acceptance test on 8 March 2018, and that the test was satisfactory. The required output was exceeded and the guaranteed heat rate was met.

1 Testing

1.1 Introduction

D3 Power Generation Ltd., (D3PG) is a subsidiary of Shanghai Electric Power Malta Holding Ltd. (SEPM). SEPM owns 90% of the shares of D3PG and Enemalta plc. owns 10%. The off-taker Power Purchase Agreement (PPA) is with Enemalta and the EPC Contractor is SEPEM. Black & Veatch is the Owner's Engineer and Mott MacDonald is the Independent Engineer. SEP-Minghua is undertaking the performance testing.

The D3 power plant, located in Delimara Bay Malta, commenced operation in 2012. It originally comprised eight 18V46 Wärtsilä engines, eight heat recovery boilers and one steam turbine (13MWe), together having a maximum generating capacity of 149.8MWe.

A phased upgrading of the power plant equipment has been undertaken with the aim of reducing fuel costs, improving emissions and improving overall plant efficiency by converting to operation mainly on re-gassified LNG instead of liquid fuel. The 18V46 Wärtsilä diesel engines were converted as per the following table:

Table 1.1: D3 Equipment Upgrading

Equipment	OEM	Pre-Conversion		Post Conversion	
		No. Off	Type	No. Off	Type
Diesel Generating Sets	Wärtsilä	8	18V46	4	18V50DF
	Wärtsilä	-	-	4	18V50SG
Heat Recovery Steam Generators	AALBORG	8	-	8	-
Steam Turbine Generator	Dresser-Rand	1	Frame 30 (13MWe)	1	-
Auxiliary Boiler		1	-	1	-

Source: D3 Power Generation Ltd.

The type 18V50DF diesel engines are dual fuel, firing LFO or gas with liquid fuel pilot ignition; and the type 18V50SG engines fire gas only with spark ignition.

The objective of these tests is to measure the heat rate, power, noise, and emissions of the units; and compare these to the benchmark data recorded prior to the conversion of the units.

The predicted performance of the units following conversion is as follows:

Table 1.2: Predicted Performance Post Conversion

Parameter	Pre-Conversion[1]	Post Conversion[2]	
Diesel Engine	8 x 18V46	4 x 18V50DF	4 x 18V50SG
Fuel	HFO	GAS/LFO	GAS
Unit Output (MWe)	17.025	16.638	18.321
Plant Output (MWe)	149.8	152.8	
Overall Plant Efficiency	47%	50%	
Emissions:	HFO	Gas / LFO	Gas
NOx (mg/Nm^3)	<160	<75 / 160	<75
CO (mg/Nm^3)	<240	<100 / 100	<100
PM (mg/Nm^3)	<10	<10 / 10[1]-30[2]	<10
SO_2 (mg/Nm^3)	<120	<15 / 70	<15
Noise		To be no worse than pre-conversion	

Source: D3 Power Generation Ltd.
Note: 1. With FGD/BF and 2. No FGD/BF

The conversion has been phased such that four units were converted to operate on dual fuel and initially proven in operation on LFO first and then gas when it became available; then the subsequent four units were converted to gas firing only (spark ignition). Being optimised for gas only, the subsequent four units will have a higher generating output (as is shown in the table above).

Together with an improvement in overall efficiency, the emissions to air from the units post conversion will be significantly reduced.

The technical details of the engines pre-conversion are as follows:

Table 1.3: D3 Technical Parameters, pre-conversion

Designation	Delimara 3 Power Plant
Diesel engine manufacturer	Wärtsilä
Diesel engine type	18V46
Diesel engine speed	500rpm
Number of engines	8 pcs
ISO shaft rating (100% MCR)	17.550 MW
Generation voltage and frequency	15kV 50Hz
Cooling type	Seawater via central coolers
Combustion air intake concept	Ducted from outside
Engine configuration	With attached LO and 2pcs CW pumps
Process configuration	With Waste Heat Recovery steam boilers and one common seawater cooled steam turbine generator unit
Fuel type	HFO,1%S
Plant environmental configuration	SCR deNOx and Particulate reduction/deSOx facility

Source: The scheme of redelivery test of the Malta Delimara 3 Power Generation Ltd

Test results are adjusted as necessary to the following reference conditions.

Table 1.4: Reference Environmental Parameters

Designation	Numerical value
Ambient reference air temperature	25°C
Reference charge air temperature (for SG engine heat rate correction)	45°C
Ambient barometric pressure	1013mbar
Ambient air humidity	65%
Seawater intake temperature	21°C
Power factor at generator terminals	>0.8

Source: The scheme of redelivery test of the Malta Delimara 3 Power Generation Ltd

For the earlier redelivery tests, the 18V46 type engines were tested to benchmark pre-conversion performance in order that comparison can be made following the conversion to gas operation.

The phase 1 converted engines #45, 46, 47 & 48 are now type 18V50DF (diesel ignited) engines and are rated at 16.6MWe. The phase 2 converted engines #41, 42, 43 & 44 are now type 18V50SG (spark ignited), rated at 18.32MWe. Both the phase1 & 2 engines have a 50cm bore.

1.2 Acceptance Test Procedure

The procedure for the acceptance tests is as detailed in the SEP-Minghua document "The Performance Test Scheme for DE41 – DE48 plus STG Whole Plant of Malta Delimara 3 Power Plant", dated January 2018.

The witnessed test schedule was as follows:

Witness Performance Acceptance Tests on natural gas, 8 March 2018, with Engines 41, 42, 43, 44, 45,46,47,48 in exhaust heat recovery mode with the steam turbine in operation:

- 2 hours @ 80% load;
- 4 hours @ 100% load;

1.3 Witness of Acceptance Testing

1.3.1 General

Mott MacDonald attended site on 8 March 2018 for the tests.

The 80% test commenced at 16:00, and the 100% test at 18:30, by which time the plant had been running at a steady 100% load for almost half an hour.

At approximately 19:10 the steam turbine tripped off load on low steam inlet temperature. This appeared and was confirmed to be due to a thermocouple fault (thermocouple failure at steam inlet) and the steam turbine could not be returned to full load until this thermocouple could be replaced.

However, as a full half-hour of full load running data had been gathered from the STG, it was decided to continue with the 100% load test running the eight engines without the STG in service, and to perform the calculations on the basis that the STG could continue to generate load as measured for the period when it was running.

This is considered satisfactory by Mott MacDonald as it does not impact the performance of the engine generator sets.

The eight engines continued to be operated at full load until 21:30.

Observations to note:

1. For the DF engines there is no measurement of the pilot fuel consumed during the tests, but pilot fuel is accounted for by adding 0.74% to the measured gas fuel energy input. The figure of 0.74% is supported by a test report and calculations provided to Mott MacDonald on 27 February 2018 (Pilot Fuel Consumption 27.09.2017.pdf and Pilot Fuel Estimate for Heat rate 27.09.2017 MP V1.xlsx). Mott MacDonald accepts the results of the test and the calculations.
2. Emissions testing had previously been carried out using calibrated test equipment and satisfactory results obtained. For this final acceptance test, the station CEMS was used. This is considered acceptable.
3. During previous tests, gas meter readings were taken by photographing the meters in each engine enclosure. However, for this test the fiscal gas flow readings from the DCS were used. This too is considered acceptable.
4. Calibration certificates were provided for all Minghua measurement equipment.
5. Fuel samples were not taken. The quality of the gas is very consistent and taking further samples was not considered worthwhile by SEP. Fuel calorific values from the on-line gas chromatograph, via the DCS, were used in calculations. Mott MacDonald is comfortable with this.
6. Noise measurements were not taken, as the plant has previously passed its noise tests. This is considered acceptable by Mott MacDonald.
7. Immediately after these Phase 2 tests, data was downloaded from the DCS. This feature had not been available during Phase 1 testing.

1.3.2 Acceptance Tests

The 100% performance acceptance test started at 18:30 on 8 March 2018 and proceeded for three hours without interruption or technical problem except for the loss of the STG at approximately 19:10, as described above.

The testing was undertaken by staff from Shanghai Minghua Electric Power Technology Engineering Co. Ltd., (SEP-Minghua):

Mr. Liao Sheng (Leo),

Mr. Han Chaobing and

Mr. Zhang Shitong.

The testing was attended by Shanghai Electric Power D3 Power Generation Ltd staff:

Ing. David Griscti,

Ing. Joseph Mifsud,

Ing. Melchior Pace,

Ing. Darren Cutajar,

Ing. Ivan Cachia,

Mr. Chen Zhichao,

Mr. Zhang Miao, and

Mr. Tian Zhiliang;

and by SEP Engineering (Malta) Co. Ltd:

Mr. Tan Qing,

Mr. Lu Mingkun,

Mr. Sun Delong, and

Mr. Xu Quanming.

The test was witnessed by Stephen David from Mott MacDonald (Independent Engineer).

It was advised that for the test the units were set up as per normal operation: the blowdown of the boilers were not isolated and demineralised water make-up to the deaerator was as per normal operation for this plant.

1.3.3 Mott MacDonald's Comments on the Acceptance Testing

Mott MacDonald confirms that it has witnessed the performance acceptance test on 8 March 2018. Mott MacDonald confirms that the test process was satisfactory except for the loss of the STG, but that sufficient data has been gathered to determine the plant performance in combined cycle mode.

2 Review of Results

2.1 General

SEP-Minghua submitted its draft report to Mott MacDonald for review by email on 9 March 2018.

SEP-Minghua's final report was provided on 17 March 2018, along with a spreadsheet of the test data and a copy of the original data sheets.

Mott MacDonald has studied the test data and has produced its own results for comparison with the results presented by Minghua. We have concentrated on the 100% load performance point in the following sections.

2.2 Adjustments Applied

It is to be noted that Wartsila has confirmed that for the SG engines the heat rate should be corrected by 0.9% per 10°C rise in reference charge air temperature above 45°C. Both parties have agreed to apply this correction, though since the charge air temperature during the test did not rise significantly above 45°C there was no requirement to do so.

An adjustment factor is also applied to the heat rate of both the SG and DF engines to account for degradation related to the number of operating hours. This is represented by a saw-tooth graph in which the heat rate degradation is linear from zero to 1.5% from zero operating hours to 18,000 hours.

2.3 Test Conditions

Test conditions were as follows, and also shown are the contract reference conditions.

Table 2.1: Ambient Conditions

Ambient Conditions	Units	Reference	8 March 100% Test
Ambient air temperature	°C	24	(average) 15.66
Seawater intake temperature	°C	21	15.94
Natural Gas LHV (@ 15°C)	MJ/kg		49.70
Power factor at generator terminals	-	0.85 (SG) / 0.8 (DF)	1.0

2.4

2.5 Gross Generation

Gross energy generated, as read from the kWh meters, is shown in the following table.

Table 2.2: Gross energy generated, 8 March 2108 test, MWh

Time	D41	D42	D43	D44	D45	D46	D47	D48	STG
1830	367306.1944	407511.9724	405349.1783	407061.7403	402766.1781	336276.092	414876.9287	424973.7172	95428.47653
1900	367315.3594	407521.1544	405358.3633	407070.9143	402774.5291	336284.439	414885.2467	424982.0372	95435.03653
1930	367324.5184	407530.3664	405367.5493	407080.0833	402782.8391	336292.754	414893.5997	424990.3762	95438.66053
2000	367333.6974	407539.5334	405376.7333	407089.2693	402791.1731	336301.093	414901.9177	424998.6852	95438.84453
2030	367342.8584	407548.7204	405385.9263	407098.4373	402799.5101	336309.44	414910.2557	425007.0092	95438.84453
2100	367352.0114	407557.9224	405395.0993	407107.6083	402807.8311	336317.755	414918.6017	425015.3432	95438.84453
2130	367361.1994	407567.1024	405404.3023	407116.7993	402816.1791	336326.104	414926.9487	425023.6402	95438.86053

2.6 Steam Turbine Generator Power Correction

The steam turbine generator power output needs to be corrected to the reference ambient air and sea water temperatures. (This is not required for the engines as the ambient conditions are not in the range in which the engines' performance deteriorates.)

The correction formula is as follows:

Corrected STG power = Measured STG power + dP_{STG}

$dP_{STG} = -62.5 (T_{amb} - T_{ref}) + 92.5 (T_{sea} - T_{sea\ ref})$

Using average temperatures over the period of operation of the STG:

$dP_{STG} = -62.5 (15.66 - 24) + 92.5 (15.94 - 21) = 53.2$ kW

As preciously indicated, due to an instrumentation fault these calculations are on the basis that the STG would have continued to generate the same amount of power throughout the 100% test as it did during the first half-hour of the test. The average power generated during the first half-hour was 13.14MW.

Hence the corrected STG power output = 13.14 + 0.053 = 13.193 MW

2.7 Auxiliary Power Consumption

Auxiliary power consumption has been inferred from the results of previous tests to be close to 3% at 100% load. This is considered to be a reasonable and slightly conservative estimate, though it is not supported by data gathered during the eight engine test.

2.8 Net Power Generated

During the 8 March test, the average gross power from the eight engines over the three hours of gathered data is: 140.09 MW.

The gross power from the STG, corrected as above, is: 13.193 MW

Hence the total net power allowing for auxiliary power as above is:

0.97 x (140.09 + 13.193) = 148,68kW.

This comfortably exceeds the reference net power output of 140MW.

2.9 Fuel Consumption

The raw fuel meter readings are shown below.

Table 2.3: Gas meter readings, kg

Time	D41	D42	D43	D44	D45	D46	D47	D48	Total
1830	1744706	7725050	7037095	7592826	1063226	1441187	1185961	1517418	29307469
1900	1746155	7726488	7038538	7594262	1064552	1442517	1187290	1518750	29318552
1930	1747602	7727923	7039986	7595701	1065879	1443846	1188618	1520082	29329637
2000	1749050	7729360	7041431	7597139	1067207	1445178	1189947	1521415	29340727
2030	1750498	7730796	7042876	7598579	1068535	1446509	1191278	1522749	29351820
2100	1751946	7732232	7044322	7600018	1069862	1447840	1192607	1524082	29362909
2130	1753396	7733669	7045770	7601458	1071191	1449172	1193935	1525413	29374004

The fuel consumed by each engine over the test is shown as follows, including a 0.74% addition to the fuel consumed by the DF engines to allow for pilot fuel consumption.

Table 2.4: Fuel consumption, MJ

Time	D41	D42	D43	D44	D45	D46	D47	D48	Total
1900	72015.3	71468.6	71717.1	71369.2	66389.9	66590.1	66540.1	66690.3	552780.6
1930	71915.9	71319.5	71965.6	71518.3	66439.9	66540.1	66490.0	66690.3	552879.6
2000	71965.6	71418.9	71816.5	71468.6	66490.0	66690.3	66540.1	66740.4	553130.3
2030	71965.6	71369.2	71816.5	71568.0	66490.0	66640.2	66640.2	66790.4	553280.2
2100	71965.6	71369.2	71866.2	71518.3	66439.9	66640.2	66540.1	66740.4	553079.9
2130	72065.0	71418.9	71965.6	71568.0	66540.1	66690.3	66490.0	66640.2	553378.1

The lower calorific value of the gas was determined from the on-line gas analyser via the DCS, averaged over the period of the test to 49.70 MJ/kg.

The total amount of fuel consumed, including the estimate for pilot fuel, is:

Gas + pilot fuel energy consumed = 3,318,529 MJ.

2.10 Heat Rate adjustments

As indicated above, a correction factor for the SG engines' charge air temperature has been agreed. However, as the charge air temperature did not rise significantly above 45°C during the test, application of this correction factor is not required.

A correction factor is required to address degradation in heat rate due to engine running hours, which were as follows at the end of the test, with the corresponding correction factors shown below:

Table 2.5: Engine running hours and degradation factor

Running hours at mid-point of test, since conversion (D41: since crankshaft replacement)							
D41	D42	D43	D44	D45	D46	D47	D48
673	2982	2704	2916	4746	4875	4813	4928
Degradation correction factor for heat rate							
0.0006	0.0025	0.0023	0.0024	0.0040	0.0041	0.0040	0.0041

The foregoing leads to the following calculated corrected heat rates for each engine:

Table 2.6: Heat rates per engine, kJ/kWh

Time	D41	D42	D43	D44	D45	D46	D47	D48
1900	7853.24	7764.26	7790.51	7760.65	7918.61	7945.46	7967.57	7982.88
1930	7847.54	7722.83	7816.66	7781.10	7963.68	7970.04	7928.22	7964.69
2000	7835.85	7771.56	7802.16	7761.31	7946.73	7965.04	7967.57	7999.44
2030	7851.25	7749.24	7794.52	7787.36	7943.87	7951.43	7960.42	7991.02
2100	7858.11	7736.61	7816.92	7779.41	7953.16	7982.03	7940.84	7975.45
2130	7838.99	7760.55	7802.22	7767.87	7939.38	7955.50	7933.92	7999.00

The above gives us an average heat rate for the eight engines, with all correction factors and adjustments included, of 7877 kJ/kWh.

Factoring in the steam turbine output, as adjusted for ambient and sea water temperature, leads to an overall plant heat rate of 7199 kJ/kWh.

Shanghai Minghua has indicated a gross heat rate of 7198 kJ/kWh, using a slightly different method, but the difference in results is negligible.

The guaranteed gross heat rate for the whole power plant is 7209kJ/kWh and therefore the test achieved this guarantee level.

2.11 Exhaust Gas Emissions

Emissions data was gathered from the CEMS during the performance test. The results are shown in Table 2.7 together with the limits stated on the IPPC permit, which limits the calendar monthly mean:

Table 2.7: Exhaust gas emissions – 8 March 2018

Exhaust gas emissions to Air, after conversion	Unit	IPPC limit (calendar monthly mean)	Stack 1 (DE41&42)	Stack 2 (DE43&44)	Stack 3 (DE45&46)	Stack 4 (DE47&48
Nitrogen Oxides (corrected to 15% Vol.O_2, dry) [NOx]	mg/Nm^3	50	36.4	35.5	35.4	35.9
Sulphur Dioxides (corrected to 15% Vol.O_2, dry) [NOx]	mg/Nm^3	10	0	0	0	0
Carbon Monoxide (corrected to 15% Vol.O_2, dry) [CO]	mg/Nm^3	100	2.2	4.0	4.5	3.9
Particulate Matter (corrected to 15% Vol.O_2, dry) [PM]	mg/Nm^3	5	3.6	3.5	0.5	1.1

Source: SEP-Minghua Formal Test Report

Clearly, the emissions produced are within the requirements.

2.12 Conclusion

This report confirms that the tests carried out on 8 March 2018 and witnessed by Mott MacDonald were performed satisfactorily. The results demonstrate that the plant output, heat rate and emissions met the guaranteed values and the plant is considered to have passed its performance acceptance test.

3 References

This document uses as its source date the following:

1. Shanghai Minghua Power Technology Engineering Co., Ltd
   "The Performance Test for DE41-DE48 plus STG Whole Plant of Malta Delimara 3 Power Plant", dated March 2018. See Appendix A.

2. [Calculation]8Engine+STG combined cycle test in 8th March 2018-xlsx"

Appendices

Shanghai Minghua Power Technology Engineering Co., Ltd

The performance test report for DE41-DE48 plus STG whole plant of Malta Delimara 3 plant

Shanghai Minghua Power Technology Engineering Co.,Ltd
2800 Yangshupu Road, Shanghai, China

March, 2018

Declaration

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Date of report submission: March, 2018

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Approver: Deputy General Manager Shanghai Minghua Power Technology Engineering Co., Ltd

Abstract:

Under the witness of Independent Engineer, Shanghai Minghua Power Technology Engineering Co., Ltd takes charge of carrying out the performance acceptance test of all eight engines in combined cycle (8+1) of Malta Delimara 3 power plant. And this performance test report presents the test results and conclusions of heat rate ,output power and emissions for the combined cycle tests.

Key words:

Performance acceptance test; Combined cycle; Heat rate; Output power; Emission;

Ⅰ The objective of test

Under the witness of Independent Engineer, Shanghai Minghua Power Technology Engineering Co., Ltd takes charge of carrying out the performance acceptance test of DE41-DE48 plus STG whole plant.

The objective of these tests is to measure the heat rate, power output and emission (including NOx, SOx, CO and PM) of all eight engines in combined cycle at various loads, thus providing the performance basis of whole plant on gas fuel mode.

Ⅱ Test condition

Table 2-1 Test condition and time of the test

NO.	Test condition	Contents of the test	Time and Date
1	80% load for DE41-DE48 engines	Test the output power and heat rate of eight engine when each engine reaches 80% load.	16:00—18:00 2018-03-08
2	80% load for combined cycle test of DE41-DE48	Test the output power and heat rate of combined cycle when each engine reaches 80% load.	16:00—18:00 2018-03-08
3	100% load for DE41-DE48 engines (8+1preliminary test)	Test the output power and heat rate of eight engine when each engine reaches 100% load.	18:30—19:30 2018-03-08
4	100% load for combined cycle test of DE41-DE48 (8+1 formal test)	Test the output power and heat rate of combined cycle when each engine reaches 100% load.	19:30—21:30 2018-03-08

Note: (1) The test of DE41-DE48 engines and combined cycle are performed

simultaneously (e.g. test NO. 1 and NO. 2 will be done at the same time)

(2) Emission levels were recorded from CEMS readings at an half hour interval during the DE41-DE48 plus STG combined cycle test .

Ⅲ Test standard

3.1 Internal combustion engines -- Determination and method for the measurement of engine power -- General requirements. **ISO 15550:2002**

3.2 Reciprocating internal combustion engines; Performance; Part 1: Declarations of power, fuel and lubricating oil consumptions, and test methods-additional requirements for engines for general use. **ISO 3046**

Ⅳ Calculation methods of the performance test

4.1 The heat rate calculation is explained in detail in 《The Performance Test Scheme for DE41-DE48 plus STG Whole Plant of Malta Delimara 3 Power Plant》 .

4.2 Pilot fuel consumption of DF engines

The pilot fuel consumption on DF engines was measured to be equivalent to 0.74 % of added energy to that of Gas fuel input rather than the original 1% quoted during commissioning by Wartsila. Thus pilot fuel energy on DF enegines will be added accordingly since this cannot be physically measured through an engine-wise meter.

4.3 Engine heat rate degradation with operating hours

Both DF and SG engine heat rate would be corrected by engine degradation with operation hours in accordance with the degradation curve from Wartsilla.

4.4 Charge inlet temperature correction of SG engines

Although It has been recently confirmed by Wartsila that SG engine heat rate goes up by appr.0.9% for every 10 degrees C rise in the charge air inlet temperature of

45 ℃, the charge air inlet temperatures were maintained very close to 45℃ during the test. So the correction of charge air temperature is not used in the performance calculation.

4.5 Gas heating values (LHV) are based on GPRS Gas chromatograph on-site, the accuracy of which has been validated by previous gas sample analysis reports from accredited lab.

4.6 The calculation of 80% load test is based on the manual recordings from DCS screen and energy meter in Local Control Room.

4.7 The calculation of 100% load test is based on the data automatically downloaded from Simulated Dispatching Software (connected with DCS database), the accuracy of which have been validated and should be taken as the same with DCS readings. The original data is downloaded under the witness of Independent Engineer and the signed data sheet is attached in this report.

4.8 After the 80% load test was completed at 18:00 PM, all eight engines were increased to 100% load immediately and kept operating at full load very stably until the end of 100% load test at 21:30 PM. STG tripped at 19:15 PM due to an instrumentation fault related with steam inlet temperature signal. However, it can be seen from the DCS trend that STG output was kept averagely at 13.14MW from 18:10 to 19:10 PM while the eight engines were running stably at 100% full load. All parties, including Independent Engineer, agree that the 13.14MW STG output can be taken as valid for the remainder of the test in order to determine the plant heat rate and output.

V Calculated result of the performance test

DE41-DE48 plus STG combined cycle (80% load test，2018/03/08 16:00-18:00)				
Item	Symbol	Unit	16:00-17:00	17:00-18:00

Gross power of DE41	P_{41}	kW	14662	14662
Gross power of DE42	P_{42}	kW	14714	14709
Gross power of DE43	P_{43}	kW	14708	14707
Gross power of DE44	P_{44}	kW	14682	14689
Gross power of DE45	P_{45}	kW	13334	13328
Gross power of DE46	P_{46}	kW	13332	13327
Gross power of DE47	P_{47}	kW	13345	13346
Gross power of DE48	P_{48}	kW	13321	13321
Gross power of STG	Pstg	kW	12092	11998
Gross power of STG Corr. to the reference condition	$P_{stg\text{-}corr}$	kW	12026	11944
Mass of gas in to 41 engine	M_{41}	kg/h	2368	2367
Mass of gas in to 42 engine	M_{42}	kg/h	2335	2333
Mass of gas in to 43 engine	M_{43}	kg/h	2353	2356
Mass of gas in to 44 engine	M_{44}	kg/h	2340	2338
Mass of gas in to 45 engine	M_{45}	kg/h	2210	2214

Mass of gas in to 46 engine	M_{46}	kg/h	2219	2222
Mass of gas in to 47 engine	M_{47}	kg/h	2211	2213
Mass of gas in to 48 engine	M_{48}	kg/h	2238	2241
LHV of gas fuel	LHV	kJ/kg	49710	49710
DE41 engine heat rate	$HR_{41\text{-}p}$	kJ/kWh	8023.97	8020.58
DE42 engine heat rate	$HR_{42\text{-}p}$	kJ/kWh	7869.01	7864.94
DE43 engine heat rate	$HR_{43\text{-}p}$	kJ/kWh	7934.75	7945.40
DE44 engine heat rate	$HR_{44\text{-}p}$	kJ/kWh	7903.48	7892.96
DE45 engine heat rate (0.74% pilot included)	$HR_{45\text{-}p}$	kJ/kWh	8267.18	8285.86
DE46 engine heat rate (0.74% pilot included)	$HR_{46\text{-}p}$	kJ/kWh	8301.19	8315.53
DE47 engine heat rate (0.74% pilot included)	$HR_{47\text{-}p}$	kJ/kWh	8263.64	8270.49
DE48 engine heat rate (0.74% pilot included)	$HR_{48\text{-}p}$	kJ/kWh	8378.81	8390.04
Gross heat rate of DE41-DE48 plus STG combined cycle	HR	kJ/kWh	7323.12	7332.49
Average of DE41-DE48 combined cycle heat rate	HR-a	kJ/kWh	7327.80	

For the formal test of DE41-DE48 plus STG combined cycle at 80% load, gross power of DE41 is 14662 kW, gross power of DE42 is 14712 kW, gross power of

DE46 engine heat rate (0.74% pilot included)	$HR_{46\text{-}p}$	kJ/kWh	7958.09	7968.59
DE47 engine heat rate (0.74% pilot included)	$HR_{47\text{-}p}$	kJ/kWh	7963.86	7937.24
DE48 engine heat rate (0.74% pilot included)	$HR_{48\text{-}p}$	kJ/kWh	7995.09	7987.05
Gross heat rate of DE41-DE48 plus STG combined cycle	HR	kJ/kWh	7197.72	7195.82
Average of DE41-DE48 combined cycle heat rate	**HR-a**	**kJ/kWh**	**7196.77**	

For the formal test of DE41-DE48 plus STG combined cycle at 100% load, gross power of DE41 is 18341 kW, gross power of DE42 is 18368 kW, gross power of DE43 is 18377 kW, gross power of DE44 is 18358 kW, gross power of DE45 is 16670 kW, gross power of DE46 is 16675 kW, gross power of DE47 is 16675 kW , gross power of DE48 is 16632 kW and gross power of STG after correction is 13193 kW .

In total, the gross output power of DE41-DE48 plus STG combined cycle Corr. to reference condition is 153288 kW, combined cycle heat rate of DE41-DE48 plus STG Corr. to reference condition is 7196.77 kJ/kWh.

VI Emission recordings from CEMS

Exhaust gas emission after abatement during DE41-DE48 plus STG combined cycle test (2018/03/08 16:00-18:00, 80% load test)

Item	Unit	Value			
Stack	-	Stack1	Stack2	Stack3	Stack4
O_2-Content in exhaust gas	Vol.-%	11.07	11.5	11.9	11.8

Nitrogen oxides(corrected at 15% Vol.-O_2)	mg/Nm^3 dry	22.5	26.3	32.5	38.5
Sulphur dioxides(corrected at 15% Vol.-O_2)	mg/Nm^3 dry	0	0	0	0
Carbon monoxide(corrected at 15% Vol.-O_2)	mg/Nm^3 dry	1.4	2.4	3.9	3.3
Particulate matters(corrected at 15% Vol.-O_2)	mg/Nm^3 dry	1.8	3	0.4	0.7

Exhaust gas emission after abatement during DE41-DE48 plus STG combined cycle test (2018/03/08 18:30-21:30, 100% load test)

Item	Unit	Value			
Stack	-	Stack1	Stack2	Stack3	Stack4
O_2-Content in exhaust gas	Vol.-%	11.63	11.51	11.47	11.49
Nitrogen oxides(corrected at 15% Vol.-O_2)	mg/Nm^3 dry	36.39	35.49	32.42	35.86
Sulphur dioxides(corrected at 15% Vol.-O_2)	mg/Nm^3 dry	0	0	0	0
Carbon monoxide(corrected at 15% Vol.-O_2)	mg/Nm^3 dry	2.19	4.02	4.53	3.88
Particulate matters(corrected at 15% Vol.-O_2)	mg/Nm^3 dry	3.57	3.49	0.49	1.10

Ⅶ Attachment

7.1 Confirmation sheet of test implementation

上海明华电力技术工程有限公司
SHANGHAI MINGHUA ELECTRIC POWER TECHNOLOGY ENGINEERING CO., LTD.

The acceptance test for DE41-DE48 plus STG Whole Plant

of Malta Delimara 3

Confirmation sheet of test implementation

At the beginning of test	1. All equipment of the unit is operating properly and system isolation condition conforms to test requirement.	
	2. All measuring instrument and meters conform to test requirement.	
	3. Test condition is in conformity with the test scheme.	
	4. Test personnel get familiar with the testing system, which conforms to test requirement.	
	All parties agree that test preparation work is well-done and the test can be formally started at 2018/3/08 .	
	Signature of D3 representative	
	Signature of EPC representative	
	Signature of Independent Engineer	
	Signature of test representative	
At the end of test	1. All data recordings are effective.	
	2. All measurements and samples are effective.	
	3. Test condition and measurement are in conformity with test scheme	
	4.Other instructions:	
	All parties agree that this test condition is effective and the test can be formally ended at 2018/3/08 .	
	Signature of D3 representative	
	Signature of EPC representative	
	Signature of Independent Engineer	
	Signature of test representative	

7.2 100% test data downloaded from SDS software

time	Output power of DE41 engine (accumlative signal)	Output power of DE42 engine(accumlative signal)	Output power of DE43 engine(accumlative signal)	Output power of DE44 engine(accumlative signal)	Output power of DE45 engine(accumlative signal)	Output power of DE46 engine(accumlative signal)	Output power of DE47 engine(accumlative signal)	Output power of DE48 engine(accumlative signal)
3/8/2018 18:30	367306.1944	407511.9724	405349.1783	407061.7403	402766.1781	336276.092	414876.9287	424973.7172
3/8/2018 19:00	367315.3594	407521.1544	405358.3633	407070.9143	402774.5291	336284.439	414885.2467	424982.0372
3/8/2018 19:30	367324.5184	407530.3664	405367.5493	407080.0833	402782.8391	336292.754	414893.5997	424990.3762
3/8/2018 20:00	367333.6974	407539.5334	405376.7333	407089.2693	402791.1731	336301.093	414901.9177	424998.6852
3/8/2018 20:30	367342.8584	407548.7204	405385.9263	407098.4373	402799.5101	336309.44	414910.2557	425007.0092
3/8/2018 21:00	367352.0114	407557.9224	405395.0993	407107.6083	402807.8311	336317.755	414918.6017	425015.3432
3/8/2018 21:30	367361.1994	407567.1024	405404.3023	407116.7993	402816.1791	336326.104	414926.9487	425023.6402

	Gas flow rate of DE41 engine (accumlative signal)	Gas flow rate of DE42 engine(accumlative signal)	Gas flow rate of DE43 engine(accumlative signal)	Gas flow rate of DE44 engine(accumlative signal)	Gas flow rate of DE45 engine(accumlative signal)	Gas flow rate of DE46 engine(accumlative signal)	Gas flow rate of DE47 engine(accumlative signal)	Gas flow rate of DE48 engine(accumlative signal)	Output Power of STG(accumlative signal)
3/8/2018 18:30	1744706	7725050	7037095	7592826	1063226	1441187	1185961	1517418	95428.47653
3/8/2018 19:00	1746155	7726488	7038538	7594262	1064552	1442517	1187290	1518750	95435.03653
3/8/2018 19:30	1747602	7727923	7039986	7595701	1065879	1443846	1188618	1520082	95438.66053
3/8/2018 20:00	1749050	7729360	7041431	7597139	1067207	1445178	1189947	1521415	95438.84453
3/8/2018 20:30	1750498	7730796	7042876	7598579	1068535	1446509	1191278	1522749	95438.84453
3/8/2018 21:00	1751946	7732232	7044322	7600018	1069862	1447840	1192607	1524082	95438.84453
3/8/2018 21:30	1753396	7733669	7045770	7601458	1071191	1449172	1193935	1525413	95438.86053

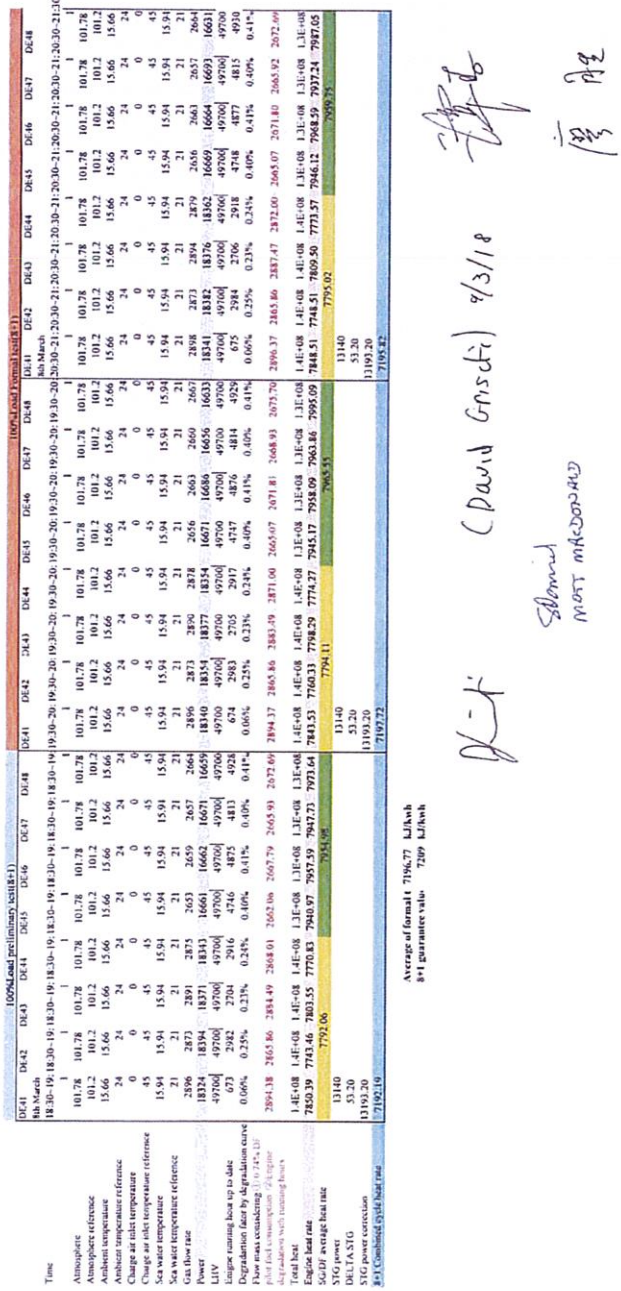
Steam turbine output average from 18:10 to 19:10 Pm is 13.14 MWh
LHV of gas during 18:30 to 21:30 pm is 49.70 MJ/kg
sea temperature from 18:30 to 21:30pm is 15.95 ℃

STEPHEN DAVID
MOTT MACDONALD

(David Grist)

7.3 Summary of calculation results for 100% and 80% load condition

100% load condition



Time	DE41	DE42	DE43	DE44	DE45	DE46	DE47	DE48	DE41	DE42	DE43	DE44	DE45	DE46	DE47	DE48	DE41	DE42	DE43	DE44	DE45	DE46	DE47	DE48
	8th March																8th March							
	18:30-19:	18:30-19:	18:30-19:	18:30-19:	18:30-19:	18:30-19:	18:30-19:	18:30-19:	19:30-20:	19:30-20:	19:30-20:	19:30-20:	19:30-20:	19:30-20:	19:30-20:	19:30-20:	20:30-21:	20:30-21:	20:30-21:	20:30-21:	20:30-21:	20:30-21:	20:30-21:	20:30-21:
Atmospheric	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Atmospheric reference	101.78	101.78	101.78	101.78	101.78	101.78	101.78	101.78	101.78	101.78	101.78	101.78	101.78	101.78	101.78	101.78	101.78	101.78	101.78	101.78	101.78	101.78	101.78	101.78
Ambient temperature	101.2	101.2	101.2	101.2	101.2	101.2	101.2	101.2	101.2	101.2	101.2	101.2	101.2	101.2	101.2	101.2	101.2	101.2	101.2	101.2	101.2	101.2	101.2	101.2
Ambient temperature reference	15.66	15.66	15.66	15.66	15.66	15.66	15.66	15.66	15.66	15.66	15.66	15.66	15.66	15.66	15.66	15.66	15.66	15.66	15.66	15.66	15.66	15.66	15.66	15.66
Charge air inlet temperature	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24
Charge air inlet temperature reference	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sea water temperature	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45	45
Sea water temperature reference	15.94	15.94	15.94	15.94	15.94	15.94	15.94	15.94	15.94	15.94	15.94	15.94	15.94	15.94	15.94	15.94	15.94	15.94	15.94	15.94	15.94	15.94	15.94	15.94
Gas flow rate	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21
Power	2896	2873	2891	2875	2653	2659	2657	2664	2896	2873	2890	2878	2656	2663	2660	2667	2898	2873	2894	2879	2656	2663	2657	2664
LHV	18324	18394	18371	18343	16661	16662	16671	16659	18340	18354	18377	18354	16671	16686	16656	16633	18341	18382	18376	18362	16669	16664	16693	16631
Engine running hour up to date	49700	49700	49700	49700	49700	49700	49700	49700	49700	49700	49700	49700	49700	49700	49700	49700	49700	49700	49700	49700	49700	49700	49700	49700
Degradation factor by degradation curve	673	2942	2704	2916	4746	4875	4813	4928	674	2983	2705	2917	4747	4876	4814	4929	675	2984	2706	2918	4748	4877	4815	4930
Heat rate considering	0.06%	0.25%	0.23%	0.24%	0.40%	0.41%	0.40%	0.41%	0.06%	0.25%	0.23%	0.24%	0.40%	0.41%	0.40%	0.41%	0.06%	0.25%	0.23%	0.24%	0.40%	0.41%	0.40%	0.41%
Total heat	2894.38	2865.86	2884.49	2868.01	2662.86	2667.79	2665.93	2672.69	2894.37	2865.86	2883.49	2871.00	2665.07	2671.81	2668.93	2675.70	2896.37	2865.86	2887.47	2872.00	2665.07	2671.80	2665.92	2672.69
Engine heat rate	1.4E+08	1.4E+08	1.4E+08	1.4E+08	1.3E+08	1.3E+08	1.3E+08	1.3E+08	1.4E+08	1.4E+08	1.4E+08	1.4E+08	1.3E+08	1.3E+08	1.3E+08	1.3E+08	1.4E+08	1.4E+08	1.4E+08	1.4E+08	1.3E+08	1.3E+08	1.3E+08	1.3E+08
SGeGT average heat rate	7850.39	7743.46	7803.55	7770.83	7940.97	7957.59	7947.73	7973.64	7843.53	7760.33	7798.29	7774.27	7945.17	7958.09	7963.86	7995.09	7848.51	7744.51	7809.50	7773.97	7946.12	7968.59	7937.24	7947.05
STG power	13140								13140								13140							
DELTA STG	53.20								53.20								53.20							
STG power correction	1193.20								1193.20								1193.20							
8+1 Combined cycle heat rate	7192.19								7199.72								7199.72							

100%Load preliminary test(8+1)

100%Load Formal test(8+1)

Average of formal t 7196.77 kJ/kwh
8+1 guarantee valu 7209 kJ/kwh

(David Grosch) 9/3/18

Edmund
MOET MACDONALD

80% load condition

80%Load Formal test(8+1)

Time	Date	DE41	DE42	DE43	DE44	DE45	DE46	DE47	DE48
	Date	8th March							
Time	Hour:mins	16:00~17:00	16:00~17:00	16.00~17.00	16:00~17:00	16:00~17:00	16:00~17:00	16:00~17:00	16:00~17:00
	Decimal hours	1	1	1	1	1	1	1	1
Atmosphere	kPa	101.75	101.75	101.75	101.75	101.75	101.75	101.75	101.75
Atmosphere reference	kPa	101.2	101.2	101.2	101.2	101.2	101.2	101.2	101.2
Ambient temperature	C	17.15	17.15	17.15	17.15	17.15	17.15	17.15	17.15
Ambient temperature reference	C	24	24	24	24	24	24	24	24
Charge air inlet temperature	C	44.56666667	45.73333333	45.73333333	45	44.83333333	44.55666667	45.73333333	44.7
Charge air inlet temperature reference	C	45	45	45	45	45	45	45	45
Sea water temperature	C	15.65666667	15.65666667	15.65666667	15.65666667	15.65666667	15.65666667	15.65666667	15.65666667
Sea water temperature reference	C	21	21	21	21	21	21	21	21
Gas flow rate	kg/h	2368	2335	2353	2340	2210	2219	2211	2238
Power	kWh	14662	14714	14708	14682	13334	13332	13345	13321
LHV	kJ/kg	49710	49710	49710	49710	49710	49710	49710	49710
Enigne running hour up to date	h	671	2980	2702	2914	4744	4873	4811	4926
Degradartion fator by degradation curve	/	0.06%	0.25%	0.23%	0.24%	0.40%	0.41%	0.40%	0.41%
Flow mass considering ① 0.74% DF pilot fuel consumption ②Engine degradation with running hours	kg	2366.68	2329.20	2347.70	2334.32	2217.55	2226.34	2218.43	2245.31
Total heat	kJ	117647458.7	115784602.4	116704257.9	116038932.9	110234533.8	110671507	110278231.7	111614172.5
Engine heat rate	kJ/kWh	8023.97	7869.01	7934.75	7903.48	8267.18	8301.19	8263.64	8378.81
SG/DF average heat rate	kJ/kWh		7932.80				8302.70		
STG power	kWh	12092							
DELTA STG	kWh	-66.13							
STG power correction	kWh	12025.87							
8+1 Combined cycle heat rate	kJ/kWh	7323.12							

Time	Date	DE41	DE42	DE43	DE44	DE45	DE46	DE47	DE48
Time	Hour:mins	17:00~18:00	17:00~18:00	17:00~18:00	17:00~18:00	17:00~18:00	17:00~18:00	17:00~18:00	17:00~18:00
	Decimal hours	1	1	1	1	1	1	1	1
Atmosphere	kPa	101.77	101.77	101.77	101.77	101.77	101.77	101.77	101.77
Atmosphere reference	kPa	101.2	101.2	101.2	101.2	101.2	101.2	101.2	101.2
Ambient temperature	C	16.75	16.75	16.75	16.75	16.75	16.75	16.75	16.75
Ambient temperature reference	C	24	24	24	24	24	24	24	24
Charge air inlet temperature	C	44.5	45.7666667	45.7333333	45.5	45.7333333	44.8666667	46.1666667	45.2333333
Charge air inlet temperature reference	C	45	45	45	45	45	45	45	45
Sea water temperature	C	15.52	15.52	15.52	15.52	15.52	15.52	15.52	15.52
Sea water temperature reference	C	21	21	21	21	21	21	21	21
Gas flow rate	kg/h	2367	2333	2356	2338	2214	2222	2213	2241
Power	kWh	14662	14709	14707	14689	13328	13327	13346	13321
LHV	kJ/kg	49710	49710	49710	49710	49710	49710	49710	49710
Enigne running hour up to date	h	672	2981	2703	2915	4745	4874	4812	4927
Degradartion fator by degradation curve	/	0.06%	0.25%	0.23%	0.24%	0.40%	0.41%	0.40%	0.41%
Flow mass considering ① 0.74% DF pilot fuel consumption ②Engine degradation with running hours	kg	2365.67	2327.20	2350.69	2332.32	2221.56	2229.35	2220.44	2248.31
Total heat	kJ	117597678.4	115685333	116852954	115939657	110433961	110821038	110377894	111763696
Engine heat rate	kJ/kWh	8020.58	7864.94	7945.40	7892.96	8285.86	8315.53	8270.49	8390.04
SG/DF average heat rate	kJ/kWh		7930.97				8315.48		
STG power	kWh	11998							
DELTA STG	kWh	-53.77							
STG power correction	kWh	11944.225							
8+1 Combined cycle heat rate	kJ/kWh	7332.49							

Average of formal test 7327.80 kJ/kwh

(David Griscti) 9/3/18

MOTT MACDONALD

SIMT 上海计量测试 ilac-MRA CNAS 中国认可 国际互认 校准 CALIBRATION CNAS L0134

校准证书编号: 2017E13-10-1272219001
Calibrated certificate series No.

SHANGHAI INSTITUTE OF MEASUREMENT AND TESTING TECHNOLOGY
NATIONAL CENTER OF MEASUREMENT AND TEST FOR EAST CHINA

校准结果/说明:
Results of calibration and additional explanation

温度/℃				
标准值	被测仪器示值		扩展不确定度(k=2)	技术要求
	IN	OUT		
15.0	15.5	15.3	0.3	MPE:±1.0
20.0	20.3	20.1		
30.0	29.8	29.9		

湿度/%RH(20℃)			
标准值	被测仪器示值	扩展不确定度(k=2)	技术要求
40.0	39	2	MPE:±5
60.0	59		
80.0	83		

结论:温度IN示值误差符合JJG874-2007第4.1.1.2条的要求。
温度OUT示值误差符合JJG874-2007第4.1.1.2条的要求。
湿度示值误差符合JJF1076-2001第8.3条的要求。
建议在2018年10月26日之前进行复校。
校准结果内容结束

校准证书续页专用
Continued page of calibration certificate

第 3 页共 3 页
Page of total pages

Calibration certificate—Electronic stopwatch

SIMT 上海计量测试 ilac-MRA CNAS 中国认可 国际互认 校准 CALIBRATION CNAS L0134

SHANGHAI INSTITUTE OF MEASUREMENT AND TESTING TECHNOLOGY
NATIONAL CENTER OF MEASUREMENT AND TEST FOR EAST CHINA

校准证书编号: 2017F34-10-1257284002
Calibrated certificate series No.

该报告/证书已确认，准予使用。
2017 年 10 月 17 日 确认人：

上海市计量测试技术研究院
华东国家计量测试中心

校 准 证 书
Calibration Certificate

委 托 者 Customer	上海明华电力技术工程有限公司
委托者地址 Address of customer	杨树浦路2800号
器 具 名 称 Name of Instrument	电子秒表
制 造 厂 Manufacturer	SASEY
型号/规格 Model/Specification	ZS-2AS
器 具 编 号 No. of instrument	M-00-87-0176
器具准确度 Instrument accuracy	/

批准人/职务 Approved by / Functions 黄玉珲 室主任

（机构校准专用章）

核 验 员 Checked by 胡立志

校 准 员 Calibrated by 张帅

校准日期 Date for calibrated 2017 年 Year 10 月 Month 16 日 Day

地址：上海市张衡路1500号(总部) Address No.1500 Zhangheng Road, Shanghai(headquarters)
电话：021-38839800 Tel. 传真：021-50798390 Fax 邮编：201203 PostCode
客户咨询电话：800-820-5172 Inquire line 投诉电话：021-50798262 Tel. for complaint

SIMT 上海计量测试 ilac-MRA CNAS 中国认可 国际互认 校准 CALIBRATION CNAS L0134

SHANGHAI INSTITUTE OF MEASUREMENT AND TESTING TECHNOLOGY
NATIONAL CENTER OF MEASUREMENT AND TEST FOR EAST CHINA

校准证书编号: 2017F34-10-1257284002
Calibrated certificate series No.

国家法定计量检定机构计量授权证书号(中心/院):(国)法计(2012)01039号/(2012)01019号
The number of the Certificate of Metrological Authorization to The Legal Metrological Verification Institution is No.（2012）01039/ No.（2012）01019

本次校准所依据的技术规范（代号、名称）：
Reference documents for the calibration (code、name)

JJG 237-2010《秒表检定规程》

本次校准所使用的主要计量标准器具：
Main measurement standards used in this calibration

名称 Name	型号规格 Model	编号 Number	测量范围 Measurement range	不确定度或准确度等级或最大允许误差 Uncertainty/Accuracy Class/Maximum Permissible Error	证书编号/有效期限 Certificate No./Due date
秒表测定仪	YQ-MB-1	14	(1～3600) s	$\pm(3\times10^{-7}\times T+3\ ms)$	2016F34-10-003993/ 2017-11-14
校表仪	Q TEST 6000	4263	（0.00～9.99）s	±0.01 s	2016F34-10-003994/ 2017-11-14
/	/	/	/	/	/

以上计量标准器具的量值溯源至国家基准。
The value of a quantity of measurement standard used in this verification is traced to those of the national primary standards in the P.R. China.

校准地点及环境条件：
Location and environmental condition for the calibration

地点： 院总部电学新楼305室
Location

温度： 20℃ Ambient temperature　湿度： 50%RH Relative humidity　其它： / Others

备注： / Note:

本证书提供的结果仅对本次被校的器具有效。
The data are valid only for the instrument(s).

校准证书续页专用
Continued page of calibration certificate

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SIMT 上海计量测试 ilac-MRA CNAS 中国认可 国际互认 校准 CALIBRATION CNAS L0134

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NATIONAL CENTER OF MEASUREMENT AND TEST FOR EAST CHINA

校准结果/说明:
Results of calibration and additional explanation

一、时间间隔测量误差:

标准值	显示值	最大允许误差（s）	误差（s）	不确定度 (k=2)
10s	10s00	± 0.05	0.00	U=0.01 s
10min	10min00s00	± 0.07	0.00	
1h	1h00min00s	± 0.10	0	U=1 s

二、日差测量误差

标准值（s）	显示值（s）	最大允许误差（s）	误差（s）	不确定度 (k=2)
0.00	-0.41	± 0.50	-0.41	U=0.01 s

校准结果内容结束